

## CLAIMS

What is claimed is:

- 1        1. A method for implementing management policies on a network using  
2 topology reduction, the network including at least a first domain having a plurality of  
3 network elements, the method comprising:
  - 4            determining a communication path passing through the first domain of  
5 the network that characterizes the first domain as a node, the communication  
6 path being characterized to pass communications without information loss; and  
7            implementing a management policy for the network using the communication path.
- 1        2. The method of claim 1, wherein implementing a management policy includes  
2 implementing a firewall configuration on the communication path.
- 1        3. The method of claim 1, wherein determining a communication path passing  
2 through the first domain includes identifying a second domain for a source element of a  
3 communication that uses the communication path, and identifying a third domain for a  
4 destination element for the communication, the second and third domain each including a  
5 plurality of network elements.

1           4.     The method of claim 1, wherein determining a communication path passing  
2     through the first domain includes:  
3                 identifying a second domain for a source element of a communication that uses the  
4     communication path, the second domain including a plurality of network elements;  
5                 identifying a third domain for a destination element for the communication, the third  
6     domain including a plurality of network elements; and  
7                 characterizing a portion of the communication path within the second domain as a  
8     distance between the source element and an interface to the second domain, the portion of the  
9     communication path within the second domain being characterized without information loss.

1           5.     The method of claim 1, wherein determining a communication path passing  
2     through the first domain includes:  
3                 identifying a second domain for a source element of a communication that uses the  
4     communication path, the second domain including a plurality of network elements;  
5                 identifying a third domain for a destination element for the communication, the third  
6     domain including a plurality of network elements;  
7                 characterizing a portion of the communication path within the second domain as a  
8     distance between the source element and an interface to the second domain, the portion of the  
9     communication path within the second domain being characterized without information loss;  
10     and  
11                 characterizing a portion of the communication path within the third domain as a  
12     distance between the destination element and an interface to the third domain, the portion of the  
13     communication path within the third domain being characterized without information  
14     loss.

1           6. The method of claim 1, wherein determining a communication path passing  
2 through the first domain includes identifying a second domain containing a source element  
3 and a destination element, a communication from the source element being signaled from the  
4 second domain to the first domain before being signaled to the destination element in the  
5 second domain.

1           7. The method of claim 1, wherein determining a communication path passing  
2 through the first domain includes:  
3           identifying a second domain for a source element of a communication that uses the  
4 communication path, the second domain including a plurality of network elements;  
5           identifying a third domain for a destination element for the communication, the third  
6 domain including a plurality of network elements;  
7           characterizing a portion of the communication path within the second domain as a  
8 distance between the source element and an interface to the second domain, the portion of the  
9 communication path within the second domain being characterized without information loss;  
10          and  
11          characterizing a portion of the communication path within the third domain as a  
12 distance between the destination element and an interface to the third domain, the portion of the  
13 communication path within the third domain being characterized without information  
14 loss; and  
15          characterizing a portion of the communication path passing through the first domain  
16 as a distance between the second domain and the third domain.

1           8.       A method for implementing management policies on a network using a policy  
2   server, the method comprising:

3              identifying a plurality of domains in the network, the plurality of domains each  
4   including a plurality of network elements;  
5              identifying a first domain in the plurality of domains having a cloudification  
6   characteristic, the first domain having at least a first management component and a  
7   corresponding interface that forms an edge to the first domain; and  
8              characterizing at least a first communication path for communications having an end  
9   element within the first domain as being a distance between the corresponding interface to  
10   the first domain and the end element, the first communication path passing communications  
11   without information loss.

1           9.       The method of claim 8, further comprising implementing a management  
2   policy using the first communication path.

1           10.      The method of claim 8, further comprising storing the first communication  
2   path as a data structure defining the distance between the corresponding interface to the first  
3   domain and the end element.

1           11.      The method of claim 8, wherein identifying a plurality of domains in the  
2   network includes identifying a plurality of management components, each management  
3   component having a corresponding interface and forming an edge for at least one domain.

1           12.     The method of claim 8, wherein identifying a plurality of domains in the  
2 network includes identifying a plurality of network elements that are interconnected between  
3 one or more interfaces of management components.

1           13.     The method of claim 8, wherein identifying a plurality of domains in the  
2 network includes identifying a plurality of firewall components, each firewall component  
3 having a corresponding interface and forming an edge for at least one domain.

1           14.     The method of claim 8, wherein identifying a first domain in the plurality of  
2 domains having a cloudification characteristic includes determining that the first  
3 management component has only one interface to the first domain.

1           15.     The method of claim 8, wherein identifying a first domain in the plurality of  
2 domains having a cloudification characteristic includes determining that each management  
3 component for the first domain has multiple interfaces to the first domain, wherein each of  
4 the multiple interfaces are configured to forward communications received from a network  
5 element within the first domain to another element or interface that is exterior to the first  
6 domain.

1           16.     The method of claim 10, wherein identifying a first domain in the plurality of  
2 domains having a cloudification characteristic includes determining that the first domain has  
3 only one or two corresponding interfaces that form edges for that domain.

1           17. A method for implementing management policies on a network using a policy  
2 server, the method comprising:

3                 identifying a plurality of domains in the network, each of the plurality of domains  
4 having at least one network element;

5                 identifying a plurality of cloudified domains from the plurality of domains, each  
6 cloudified domain being bounded by a management component and at least one interface for  
7 the management component;

8                 identifying a source element and a destination element for a communication; and

9                 defining a plurality of communication paths passing within a first cloudified domain  
10 in the plurality of cloudified domains, each of the plurality of communication paths  
11 characterizing the first cloudified domain as a distance between an interface to the first  
12 domain and an end point element, the end point element characterizing at least one of the  
13 source element and the destination element, each of the plurality of communication paths  
14 passing communications within the first cloudified domain without information loss. and

1           18. The method of claim 17, further comprising implementing a management  
2 policy using one of the communication paths.

1           19. The method of claim 17, further comprising selecting a communication path  
2 from the plurality of communication paths, and implementing a management policy using the  
3 selected communication path

1           20.     The method of claim 17, wherein defining the plurality of communication  
2     paths includes characterizing one or more of the communication paths as a data structure that  
3     defines a distance between a network element of that domain and an interface to the  
4     management component of that domain.

1           21.     The method of claim 17, wherein defining the plurality of communication  
2     paths includes:

3                 characterizing one or more of the communication paths as a first data structure that  
4     defines a distance between each network element of that domain and an interface to the  
5     management component of that domain; and  
6                 characterizing the one or more communication paths as a second data structure that  
7     defines a distance between two or more interfaces that bound that domain.

1           22.     The method of claim 17, wherein identifying at least a first path in the  
2     plurality of communication paths includes characterizing the communication passing through  
3     a second cloudified domain in the plurality of domains as a node.

1           23.     The method of claim 16, wherein identifying at least a first path in the  
2     plurality of communication paths includes:

3                 characterizing the communication passing through a second cloudified domain in the  
4     plurality of domains as a node; and  
5                 characterizing the communication passing through a third cloudified domain in the  
6     plurality of domains as a second distance between an interface to the third cloudified domain  
7     and an end point element within the third cloudified domain.

1           24. A method for implementing management policies using a policy server that is  
2 communicatively coupled to one or more managed devices in a network, the method  
3 comprising:

4           identifying a plurality of domains in the network, each of the plurality of domains  
5 having at least one network element;

6           identifying a plurality of cloudified domains from the plurality of domains, each  
7 cloudified domain being bounded by one or more management components and at least one  
8 interface for each of the one or more management components;

9           determining a first data structure for each of the plurality of cloudified domains, the  
10 first data structure including a data element that specifies a distance between each network  
11 element in that cloudified domain and the at least one interface for the one or more  
12 management component that bound that cloudified domain;

13           determining a second data structure for each of the cloudified domains, the second  
14 data structure including a data element that specifies a distance between each of the  
15 interfaces of the one or more management components that bound the cloudified domain; and  
16           storing the first data structure and the second data structure.

1           25. The method of claim 24, further comprising accessing the first data structure  
2 and the second data structure to determine a first path for passing communications without  
3 information loss within at least one of the cloudified domains.

1           26. The method of claim 24, further comprising determining a plurality of paths  
2       for passing communications without information loss within the at least one of the cloudified  
3       domains using the first data structure and the second data structure, and selecting a first path  
4       from the plurality of paths.

1           27. The method of claim 24, further comprising accessing the first data structure  
2       and the second data structure to determine a plurality of paths for passing communications  
3       without information loss within the at least one of the cloudified domains, and selecting a first  
4       path from the plurality of paths having a smallest distance for passing the communications.

1           28. A computer readable medium for implementing a management policy on a  
2 network, the computer readable medium carrying instructions for performing the steps of:  
3           identifying a plurality of domains in the network, each of the plurality of domains  
4 having at least one network element;  
5           identifying a plurality of cloudified domains from the plurality of domains, each  
6 cloudified domain being bounded by one or more management components and at least one  
7 interface for each of the one or more management components;  
8           determining a first data structure for each of the plurality of cloudified domains, the  
9 first data structure including a data element that specifies a distance between each network  
10 element in that cloudified domain and the at least one interface for the one or more  
11 management component that bound that cloudified domain;  
12           determining a second data structure for each of the cloudified domains, the second  
13 data structure including a data element that specifies a distance between each of the  
14 interfaces of the one or more management components that bound the cloudified domain; and  
15           storing the first data structure and the second data structure.

1           29. The computer readable medium of claim 28, further comprising instructions  
2 for accessing the first data structure and the second data structure to determine a first path for  
3 passing communications without information loss within at least one of the cloudified  
4 domains.

1       30.     The computer readable medium of claim 28, further comprising instructions  
2     for determining a plurality of paths for passing communications without information loss  
3     within the at least one of the cloudified domains using the first data structure and the second  
4     data structure, and selecting a first path from the plurality of paths.

1       31.     The computer readable medium of claim 28, further comprising instructions  
2     for accessing the first data structure and the second data structure to determine a plurality of  
3     paths for passing communications without information loss within the at least one of the  
4     cloudified domains, and selecting a first path from the plurality of paths having a smallest  
5     distance for passing the communications.

1       32.     A computer system to implement management policies on a network using  
2     topology reduction, the network including at least a first domain having a plurality of  
3     network elements, the computer system comprising:

4              means for determining a communication path passing through the first  
5     domain of the network that characterizes the first domain as a node, the  
6     communication path being characterized to pass communications without  
7     information loss; and

8              means for implementing a management policy for the network using the  
9     communication path.

1        33. A policy server communicatively coupled to one or more managed devices in  
2 a network to implement a management policy using topology reduction, the policy server  
3 comprising:  
4            a processor configured to:  
5                  identify a plurality of domains in the network, the plurality of domains each  
6 including a plurality of network elements;  
7                  identify a first domain in the plurality of domains having a cloudification  
8 characteristic, the first domain having at least a first management component and a  
9 corresponding interface that forms an edge to the first domain; and  
10                characterize at least a first communication path for communications having an  
11 end element within the first domain as being a distance between the corresponding  
12 interface to the first domain and the end element, the first communication path  
13 passing communications without information loss.